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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/734,328	12/12/2003	Mohammed Shaarawi	200309536-1	1352
22879 7590 07/20/2007 HEWLETT PACKARD COMPANY P O BOX 272400, 3404 E. HARMONY ROAD INTELLECTUAL PROPERTY ADMINISTRATION FORT COLLINS, CO 80527-2400			EXAMINER RAYMOND, BRITTANY L	
			ART UNIT 1756	PAPER NUMBER
			MAIL DATE 07/20/2007	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	Application No. 10/734,328	Applicant(s) SHAARAWI ET AL.	
	Examiner Brittany Raymond	Art Unit 1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 08 July 2007.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-52 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-52 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                     | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
  2. Ascertaining the differences between the prior art and the claims at issue.
  3. Resolving the level of ordinary skill in the pertinent art.
  4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
2. Claims 1, 6, 11, 12, 16, 21, 22 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6007324) in view of Tashiro (U.S. Patent Publication 2004/0257506).

Tzu ('324) discloses a method of making a resist pattern comprising the steps of exposing a first pattern in the top and bottom portions of the layer, exposing a second pattern into the top portion of the layer with a second exposure dosage, wherein the first pattern lies within the second pattern and the first exposure dose is greater than the second exposure dose, and developing the photoresist (Claim 1), as recited in claims 1 and 11 of the present invention. Since the patterns overlap, this forms a third portion that is exposed twice. While Tzu ('324) does not teach if the photoresist is positive or

negative, it is clear from the description in column 6, lines 37 to 41 and 64 to 67 and Figures 4 and 5, that the photoresist is positive. This means that this process would be the opposite of what is recited in claim 11 in the present invention. However, the developing process of Tzu ('324) forms the same pattern with a void extending through the layer in the third portion and a depression forming at the surface of the second portion, which encloses the void (See Figure 4), as stated in claim 12 of the present invention. Tzu ('324) shows that the pattern of the first mask has a non-transmissive portion, which corresponds to the first and second portions of the present invention, and a transmissive portion, which corresponds to the third portion of the present invention (Figures 3 and 4). Tzu ('324) also shows that the pattern of the second mask has a non-transmissive portion, which corresponds to the first portion of the present invention, and a transmissive portion, which corresponds to the second and third portions of the present invention (Figures 3 and 4). The first and second masks are the opposite of what is claimed in the present invention because the photoresist of Tzu ('324) is positive, whereas the photoresist of the present invention is negative. If the photoresist of Tzu ('324) were negative, then the masks would match what is claimed in claims 6 and 16 of the present invention. Also, if the photoresist of Tzu ('324) were negative, the exposure dose used to form the depression at the top of the photoresist would be greater than the dose used to form the contact hole, as recited in claims 1, 6, 11, and 16. When the masks are exposed together, they have transmissive, partially transmissive and non-transmissive portions that expose the three different portions of the resist, as stated in claim 29 of the present invention. In the description of the

invention, Tzu ('324) states that the first exposure occurs before the second exposure (Column 5, Lines 13-19), which is claimed in claim 21 of the present invention. Tzu ('324) also states that the exposure steps can be reversed, having the second exposure before the first exposure (Column 5, Line 48), as claimed in claim 22 of the present invention.

Tzu ('324) fails to disclose that a baking step forms a depression at the surface of the layer in the first or second portion of the layer.

Tashiro discloses an embodiment for forming a liquid crystal display device comprising: forming a photosensitive resin on a substrate surface, prebaking the substrate, irradiating the photosensitive resin with ultraviolet light, and a first and second bake that are used to form projections and depressions in the photosensitive resin layer. (Paragraph 0206), as recited in claim 1 of the present invention.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have used the baking step to form the depression in the surface of the layer, as suggested by Tashiro, in the process of Tzu ('324) because Tashiro teaches that a baking step, rather than a development step, can be used to form depressions in areas of a photosensitive layer that have been exposed to radiation, in order to produce a desired pattern.

3. Claim 3, 5, 25-28 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6007324) in view of Tashiro (U.S. Patent Publication 2004/0257506) as applied to claims 1, 4, 6, 11, 12, 16, 21, 22-24 and 29 above, and further in view of Cauchi (U.S. Patent Application 2004/0101790).

The teachings of Tzu ('324) and Tashiro have been discussed in paragraph 2 above.

Tzu ('324) and Tashiro fail to disclose that the photoresist layer is baked at a temperature in the range of 80-120 degrees Celsius, that it is baked for up to five minutes, that the layer is baked after the first exposure and after the second exposure, and that the photoresist is negative.

Cauchi ('790) discloses a photoresist exposure process that has two exposures, each having a baking step afterwards (See Figure 2), as recited in claims 4, 5 and 23-26 of the present invention. Cauchi ('790) states that the baking takes place for 90 seconds at between 110 and 140 degrees Celsius (Paragraph 0027), which are within the ranges recited in claims 3, 27 and 28 of the present invention. Cauchi ('790) also states that a negative photoresist may be used in the process (Paragraph 0021), as recited in claim 30 of the present invention.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the processes of Tzu ('324) and Tashiro by having the baking step last in the range of 90 seconds long at a temperature around 110 to 140 degrees Celsius, as suggested by Cauchi ('790), because Cauchi ('790) teaches such temperature and time ranges lead to an improved pattern in a lithographic process using two exposures at different exposure doses. It also would have been obvious to one of ordinary skill in the art to have performed two baking steps, one after each exposure, as suggested by Cauchi ('790), because Cauchi ('790) teaches that the baking steps promote solubility so that the development step can form a desirable

photoresist pattern. It also would have been obvious to one of ordinary skill in the art to have used a negative photoresist, as suggested by Cauchi ('790), because Cauchi ('790) teaches that both positive and negative photoresists can be used in photolithographic processes with two exposures.

4. Claims 13-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6007324) in view of Tashiro (U.S. Patent Publication 2004/0257506) as applied to claims 11, 12, 16, 21 and 22-30 above, and further in view of Okoroanyanwu (U.S. Patent 6589713).

The teachings of Tzu ('324) and Tashiro have been discussed in paragraph 2 above.

Tzu ('324) and Tashiro fail to disclose that the void's lower portion and the depression have substantially circular cross-sections, the circumference of the void's lower portion is within the circumference of the depression, the depression has a generally parabolic shape, and the void's lower portion and the depression are substantially concentric.

Okoroanyanwu discloses a process for forming vias wherein radiation is provided through a mask to form an aperture, which can be circular in shape (Column 4, Line 35), as recited in claim 13 of the present invention. A step of etching is performed after this to form a circular hole within the aperture (Column 5, Lines 35-40), also recited in claim 13 of the present invention. When formed, the aperture can have a parabolic shape (See Figure 4), as recited in claim 14, and it is concentric with the circular hole (See Figure 15), as recited in claim 15.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the methods of Tzu ('324) and Tashiro by making the depression and void circular in shape, such as a parabolic shape for the depression, with the void lying within the depression, as suggested by Okoroanyanwu, because the purpose of the invention is to produce a fluid emitter and fluid is able to flow more easily through a shape with rounded edges. It would have also been obvious to have made the void and depression concentric, as suggested by Okoroanyanwu, because more fluid can be emitted at one time if the two have a common center.

5. Claims 31-36, 41-48, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6007324) in view of Tashiro (U.S. Patent Publication 2004/0257506), Okoroanyanwu (U.S. Patent 6589713), and/or Cauchi (U.S. Patent Application 2004/0101790) as applied to claims 11-15, and 21-30 above, and further in view of Makigaki (U.S. Patent 6863375).

The teachings of Tzu ('324), Tashiro, Okoroanyanwu and Cauchi ('790) have been discussed in paragraphs 2-4 above.

Tzu ('324), Tashiro, Okoroanyanwu and Cauchi ('790) fail to disclose forming a nozzle and counter bore in the photoresist layer.

Makigaki discloses a silicon nozzle plate that has nozzles each with a first nozzle portion and a second nozzle portion that both have circular cross-sections. The circular cross-section of the first nozzle is smaller than the circular cross-section of the second nozzle portion (Claim 1). The first and second nozzle portions are formed by patterning a resist film, formed on a substrate (Claim 2). Makigaki also discloses that an ink



supply hole, which is assumed to be similar to a counter bore, can be formed at the bottom of the nozzle (Column 6, Line 33).

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the methods of Tzu ('324), Tashiro, Okoroanyanwu, and Cauchi ('790) by further forming a nozzle and counter bore in the layer, as suggested by Makigaki, because Makigaki teaches that it is known to make a fluid emitting nozzle photolithographically using photoresist films.

6. Claims 7-10, 17-20, 37-40, and 49-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzu (U.S. Patent 6007324), Tashiro (U.S. Patent Publication 2004/0257506), Okoroanyanwu (U.S. Patent 6589713), and/or Cauchi (U.S. Patent Application 2004/0101790) as applied to claims, 1, 6, 11, 16, 31, and 36.

The teachings of Tzu ('324), Tashiro, Okoroanyanwu, and Cauchi ('790) have been taught in paragraphs 2-4 above.

Tzu ('324), Tashiro, Okoroanyanwu, and Cauchi ('790) fail to teach the range of doses recited in claims 7-10, 17-20, and 37-40. They also fail to teach the range of sizes recited in claims 49-51.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have used the range of doses and range of sizes recited in the claims being rejected because the range of exposure doses depends on the photoresist being used and can be determined by one of ordinary skill in the art without undue experimentation to form the desired nozzle with the desired dimensions.

***Response to Arguments***

7. Applicant's argument, regarding the improper filing of the prior final office action, has been considered and is persuasive. Therefore, Examiner has considered Applicant's arguments and has made this office action non-final.

8. Applicant's arguments, filed 7/8/2007, with respect to the rejection(s) of claim(s) 1-52 under 35 USC 103(a) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of the different interpretation of the previously applied prior art references.

The reference, Tzu ('324), is now being used in the rejection of independent claims 1 and 11 of the present invention. Tzu ('324) teaches the use of two different doses of energy for the two exposures of the photoresist layer, as recited in claims 1 and 11 of the present invention.

The reference, Tashiro, is being used to teach that a baking step can be used to form a depression in the areas where a photoresist has been exposed. If the type of post exposure baking, performed in Tashiro, is used in the process of Tzu ('324), depressions would form in the two areas that were exposed, and the development process of Tzu ('324) would then follow this to remove the rest of the exposed photoresist, such as to form the rest of the through hole within the pattern at the top of the photoresist. The use of the post exposure step of Tashiro would allow for the pattern formed at the top of the resist layer of Tzu ('324) to have a rounded shape rather than a square one, as recited in the present invention.

Independent claim 31 and all dependent claims are now rejected in view of the new grounds of rejection, using Tzu ('324) in view of Tashiro.

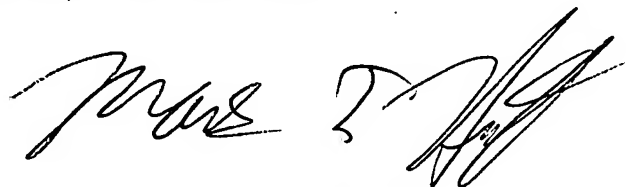
**Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brittany Raymond whose telephone number is 571-272-6545. The examiner can normally be reached on Monday through Friday, 8:00 a.m. - 4:30 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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MARK F. HUFF  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 1700